

**BOHPA MACULATA, A NEW GENUS AND SPECIES OF CEINAE FROM
SOUTH AFRICA (HYMENOPTERA: CHALCIDOIDEA: PTEROMALIDAE)**

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Abstract.—A new genus and species of Ceinae is described from the Transvaal region of South Africa; this is the first record of the subfamily outside of the Holarctic and Neotropical regions. The genus is compared with the two other ceine genera, *Cea* Walker and *Spalangiopelta* Masi and autapomorphic features of the structure of the metasoma are discussed. *Bohpa maculata* n. gen., n. sp., is a very small wasp with a highly modified structure of the mesosoma and wings; and specimens have been only collected with ground traps, both of which suggest a primarily hypogaecic existence.

Key Words: Wing reduction, morphology, subterranean habits

During my studies of the world species of *Spalangiopelta* Masi (Darling, in press), I encountered an undescribed genus and species of Ceinae from South Africa. The subfamily was previously known from only the Holarctic and Neotropical regions, and this is the first record from the Ethiopian region. This genus and the type species are described herein and compared with the other two described genera of Ceinae, *Cea* Walker and *Spalangiopelta*.

The Ceinae can be generally recognized by the following combination of character states (Darling, in press): (1) notauli complete; (2) propodeal spiracle situated halfway between the anterior and posterior margins of propodeum; (3) clypeus reduced, antennal toruli separated from oral fossa by a distance less than diameter of torulus; (4) antenna with three annelli, antennal formula 11353; (5) marginal vein long; and (6) mandibles bidentate.

Many species of Ceinae are closely associated with subterranean environments (Darling, in press). All three genera possess

structural features that I interpret as specializations for life underground. For example, wing reduction occurs in all three genera and is correlated with morphological modification of the mesosoma. Parallel modifications are found in the Ceinae and in *Tetracyclos* Kryger (Encyrtidae) and these are discussed herein.

Terms and abbreviations.—Metasomal tergites are designated T1–T8; T1 is the “petiole” and T2–T8 form the “gaster.” The antenna consists of the scape, pedicel, three annelli (A1, A2, A3), five funicular segments (F1–F5), and three claval segments (C1–C3) that are referred to collectively as the “club.” For all measurements, length, width, and height are maximum values obtained by rotating the specimen. Measurements and abbreviations are as follows: EH, eye height; F1, F2, etc., length of funicle segment 1, 2, etc. in lateral view; HL, head length in dorsal view; HW, head width in frontal view; MS, length of malar space; MSC, length of mesoscutum along midline; OOL, length of ocular-ocellar line; PN,

length of pronotum along midline; POL, length of postocellar line; SC, length of scutellum along midline; and SL, scape length. Museum acronyms: British Museum (Natural History), London (BMNH); Canadian National Collection of Insects Arachnids and Nematodes, Ottawa (CNC); National Museum of Natural History, Washington, D.C. (USNM); Royal Ontario Museum, Toronto (ROM); Transvaal Museum Pretoria (TMP).

Bohpa Darling, NEW GENUS

Etymology.—*Bohpa* is the Zulu word for “arrest” or “confinement” and is an allusion to the restricted subterranean habitats frequented by the type species. The gender is feminine.

Type species.—*Bohpa maculata* Darling, **NEW SPECIES.**

Diagnosis.—The structure of the metanotum and propodeum will distinguish this genus from both other genera of Ceinae. The scutellum is vaulted over the propodeum in lateral view (i.e. the mesonotum and propodeum at an angle of about 90 degrees) (Fig. 1), the metanotum is very short without a distinct dorsellum (Fig. 9), and the propodeum is strongly transverse with a very broad nucha, without carinae or foveae (Fig. 9). In *Cea* and *Spalangiopecta* the mesosoma is much more elongate in habitus (see Graham 1969, fig. 51 and Darling and Hanson 1986, fig. 1, respectively), and in profile the mesosoma is either flattened or rounded with the mesonotum and propodeum at an angle of 135–160 degrees. The metanotum is also much longer in these two genera and there is a distinct dorsellum. *Bohpa* can also be differentiated from *Spalangiopecta* by the structure of the pleuron; in *Bohpa* and *Cea* the mesopleuron and metapleuron abut (Fig. 6) whereas the mesopleuron overlaps the metapleuron in *Spalangiopecta* (Darling, in press, figs. 1, 9). The latter state is regarded as an autapomorphy of *Spalangiopecta*. The structure of the antenna is similar in *Bohpa* and *Spalangiopecta*, but distinguishes *Bohpa* from *Cea*. In *Bohpa* the radicle is small

and there is a distinct 3-segmented club (Figs. 4–5) whereas in *Cea* the radicle is very long and there is no distinct club (Darling, in press, fig. 19).

Description.—Female. Robust in habitus, metasoma sessile. General body color light brown, with notaulus, axilla, an axillula indicated by darker lines in pinned material, sutures not distinct with SEM (Fig. 7). Forewing reduced to form a sclerotized lobe, with large compound (bifurcated) apical setal process (Fig. 8); hindwing reduced or absent.

Head: Clypeus small, transverse; antennal toruli separated from oral fossa by less than diameter or torulus; scrobal cavity deep with high triangular interantennal callus (Fig. 2); compound eye with reduced number of rather large ommatidia giving the appearance of “raspberry eyes,” with short setae between ommatidia (Fig. 5); ocelli vestigial, indicated by dark brown spots in pinned material, anterior ocellus not evident with SEM, posterior ocelli extremely reduced (non-functional?) but present, situated high on vertex, OOL equal to POL; malar sulcus absent (Fig. 5). Antenna (Fig. 4): radicle small, about one-sixth scape length; pedicel elongate, length twice maximum width, much longer than F1; combined length of annelli greater than F1; F1 transverse, length one-half width and less than one-half length of distad flagellar segments, without multiporous plate sensilla; club 3-segmented; papilliform sensilla not detected on flagellum and club; enlarged, anteriorly-directed seta absent on dorsal surface of F1–F5 and club; apex and ventral surface of C3 with surface sensilla, without erect peg-like sensilla (Fig. 4, cf. *Spalangiopecta*, Darling, in press, fig. 6).

Mesosoma: Arched in lateral view, scutellum produced over propodeum, mesonotum and propodeum making an angle of about 90 degrees (Fig. 1); pronotum elongate, without distinct collar (Fig. 7), length 0.6–0.7 maximum width, longer than mesoscutum, PN/MS = 1.1; tegula very small

(Figs. 6, 8); scutellum shorter than mesoscutum, SC/MSC = 0.6, with rolled rim indicated laterad, apex broadly rounded (Figs. 7, 9); metanotum very short, straplike, without distinct dorsellum (Fig. 9); propodeum strongly transverse, width about 4 times length along midline, with very broad nucha, without carinae or foveae (Fig. 9), with long seta present beneath spiracle; posterior margin of mesopleuron simple, not projected roof-like over metapleuron as in *Spalangiopecta* (Fig. 6).

Metasoma (Figs. 1, 3): petiole inconspicuous, only visible with dissection, strongly transverse, length about 0.2 width; hypopygium extended to middle of gaster, without distinct mucro, with lateral processes; cerci plate-like, with 1 long and 2 smaller setae; ovipositor long, subequal in length to gaster, ovipositor sheaths extended only slightly beyond apex of gaster.

Remarks.—Both *Bohpa* and *Spalangiopecta* are characterized by apomorphic configurations of the mesosoma, relative to *Cea*. I regard these structural modifications as divergent evolutionary responses to a subterranean mode of life. In *Cea*, the mesosoma has a typical pteromalid structure; wing length variation, the presence of both brachypterous and macropterous females in *Cea pulicaris* Walker, is the only morphological feature that might be considered as an adaptation to life underground. This dimorphism in wing structure may be a result of differing selection pressures with respect to host finding. The brachypterous females may be better able to move through the litter and duff in search of hosts and the macropterous females may be better able to disperse in search of suitable habitats or hosts. In *Spalangiopecta*, the apomorphic configuration of the mesosoma may allow the relative movement of the metapleuron and propodeum and result in increased flexibility (see Darling, in press for discussion). The genus *Bohpa* is described and recognized because of the highly modified structure of the mesosoma and a suite of char-

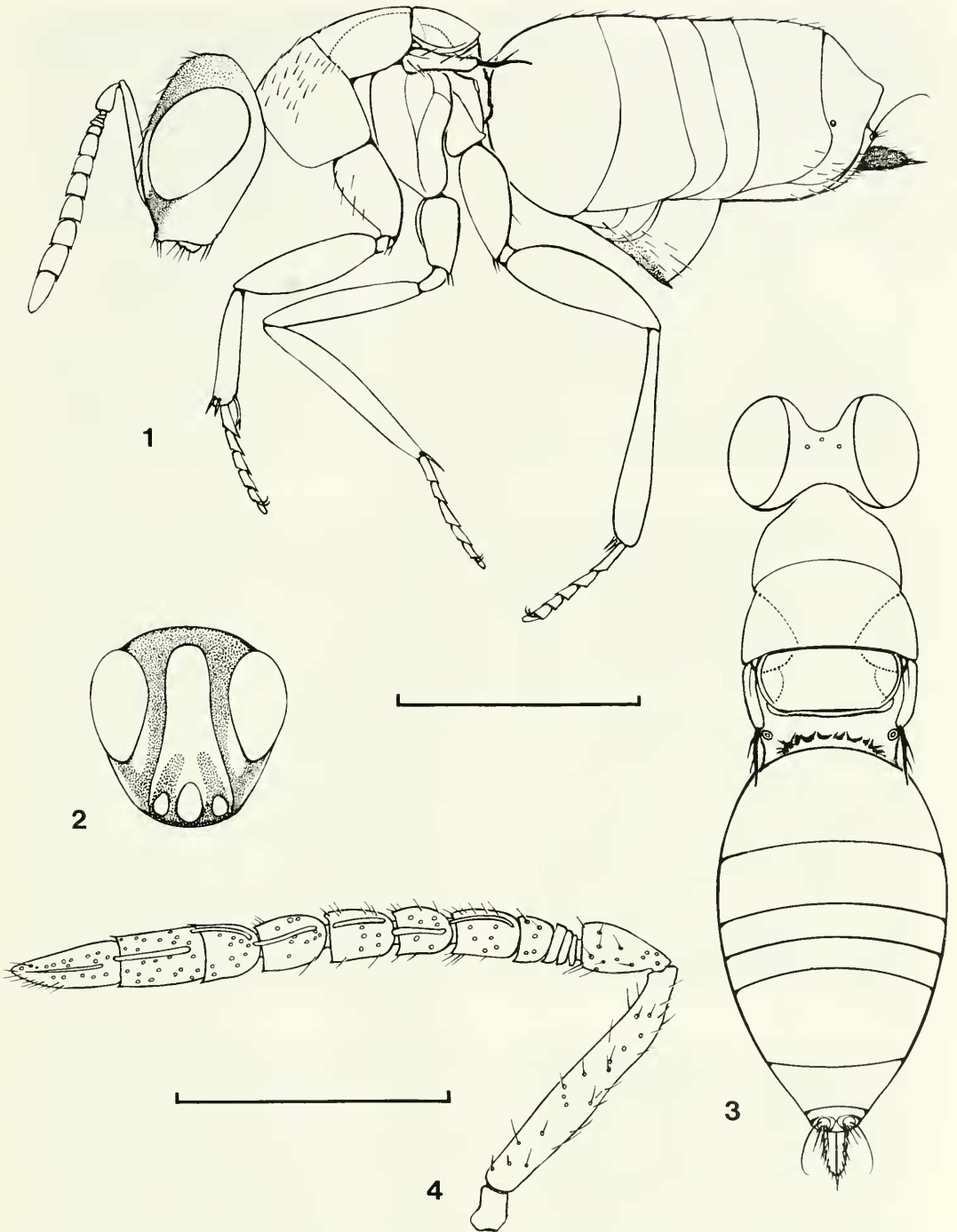
acters that are regarded as modifications for a primarily hypogaeic or subterranean existence. The wasps are extremely small and compact; the metasoma is sessile and there is a close association of the mesosoma and metasoma through a reduction in the size of the propodeum (Figs. 1, 3) and petiole. In addition, the forewing is highly reduced and modified (Figs. 6, 8, 9), the hindwing is reduced or absent, the notauli (Fig. 7) and ocelli (Fig. 10) are vestigial, the general body color is light, and the body has reduced sculpture. These are regarded as generic characters for *Bohpa* and other morphological features are described for the type species of the genus. The generic description will need to be revised should additional species be referred to the genus and should the male be discovered.

***Bohpa maculata* Darling,
NEW SPECIES**

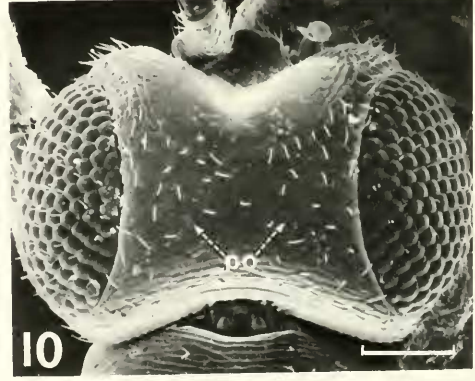
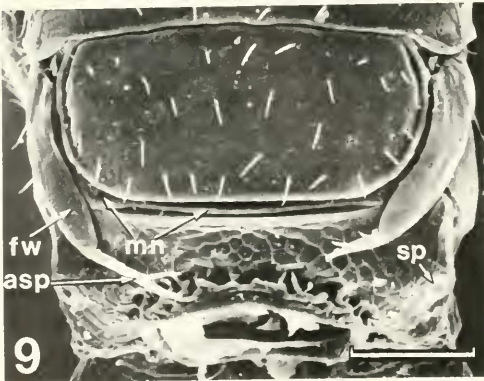
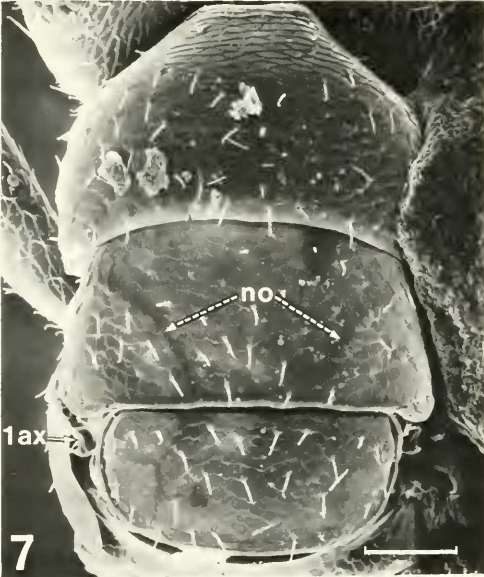
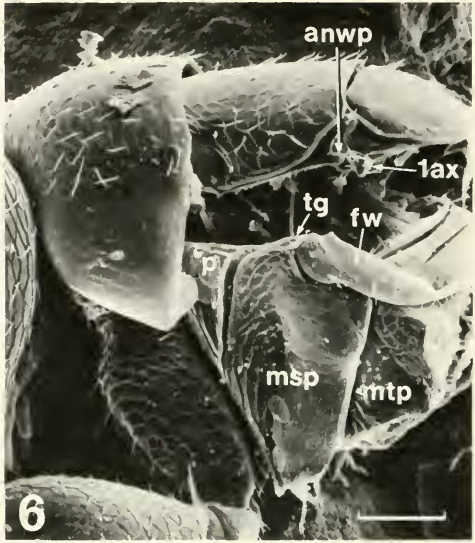
Type locality: Transvaal, South Africa.

Type material: All from South Africa. Holotype +: "S. Afr., E. Transvaal, 16 km N. Barberton 25.42S-30.57 E," "30.11.-1986; E-Y:2331 groundtraps, 53 days leg. Endrödy-Younga," "groundtraps with meat bait." Paratypes (7 ♀♀): same data as holotype (4 ♀♀: TMP, ROM, CNC, USNM); "S. Afr. Transvaal Frm: Rhenosterpoort 25.43S-28.56E," "16.11.1975; E-Y:937 sifted litt. in bush leg. Endrödy-Younga" (2 ♀♀, TMP, ROM); "S. Afr; Tvl Nelspruit Nat. Res., dry valley 25.29S-30.55 E," "23.9.1986; E-Y:2286 groundtraps, 33 days leg. Endrödy-Younga," "groundtrap with banana bait" (1 ♀♀; TMP, BMNH).

Additional material examined: 3 ♀♀: same data as holotype (1 ♀, coated for SEM; 1 ♀, head missing, D. Chris Darling Slide No. 1424 [prothorax, mesothorax], 1425 [metanotum, propodeum, metasoma]; both ROM); "S. AFR. Anthrax Camp, Pafuri, Kruger N. P. 15 km W. Jct. Limpopo R. & Levuvhu R. 9-24.XI.85 M. Brigham" (1 ♀; D. Chris Darling Slide No. 910, antenna;



Figs. 1-4. *Bohpa maculata*. 1, Lateral habitus. 2, Head, frontal view. 3, Dorsal habitus. 4, Antenna. Scale lines: Figs. 1-3, 0.25 mm; Fig. 4, 0.01 mm. Note: stippling in Figs. 1-2 denotes areas of darker color.



specimen damaged, metasoma coated for SEM; ROM).

Type repository: Transvaal Museum, Pretoria, South Africa.

Etymology: The specific epithet is from the Latin for "spotted" or "dappled" and is a reference to white spots or maculations on the head.

Diagnosis: This is the only described species of *Bohpa*; the generic diagnosis will distinguish this species. It is also likely, based on species-specific characters in *Spalangio-pelta*, that the pattern of white maculations of the head will distinguish this species from any as yet undiscovered species of the genus.

Distribution: This species is currently recorded from only the Transvaal region of South Africa. The following information about the 3 collecting localities for the type material is summarized from information kindly provided by Dr. S. Endrödy-Younga (*in litt.*). All specimens were collected in spring and early summer from traps and samples collected in areas of dense bush cover, but from a range of habitat types. Specimens were collected from both the subtropical parts of eastern Transvaal (E-Y:2286 and 2331), which has higher rainfall and temperatures that do not usually fall below freezing, and from the Transvaal Highlands (E-Y:937), which has lower rainfall and regular winter frost.

Host: Unknown.

Description: Female. Length, 0.8–0.9 mm. Head, mesosoma, and metasoma light brown to yellow in color, with blue-violet iridescent reflections on dorsum of head and mesosoma, except: head with interantennal callus, scrobal cavity, gena, outer and lower inner orbit white (darker regions indicated

by stippling, Figs. 1–2, head only); legs and antenna light brown, except: radicle, scape, and pedicel lighter; ovipositor sheaths dark brown. Sculpture finely imbricate (Figs. 6, 7) unless otherwise noted, uniformly covered with short setae, longer and denser on metasoma.

Head: In frontal view quadrate, maximum width equal to height, wider than pronotum; in dorsal view transverse, HW/HL = 1.6–1.7; MS/EH = 0.4–0.5. Antenna (Fig. 4): scape long, length about 9 times maximum width, length greater than eye height, SL/EH = 1.1–1.2, spindle-shaped, slightly expanded in lateral view; A1, A2, and A3 subequal in length, length about one-quarter width; A1 trapezoidal, A2 and A3 transverse; F2–F5 longer than F1, length slightly greater than width; clava slightly shorter than F1–F5 (54:59), segments conical, equal in length on dorsal and ventral surface.

Mesosoma: Notauli indicated by dark lines, distinct in slide-mounted specimen but not by SEM (Fig. 4); frenum not differentiated from scutellum; propodeum alveolate, with deep rugose nuchal groove (Fig. 9); prepectus narrowly triangular, without rounded flange at upper posterior corner (Fig. 6).

Metasoma (Fig. 1): T5 subequal in length to following two tergites combined; ovipositor sheaths extended beyond apex of gaster by about one-third length of hind tibia.

Variation.—The only notable variation among the specimens available for study concerns the length of the forewing and the apical setal process. In lateral view, the forewing can extend either just to the midpoint of the scutellum or past the propodeal spiracle. The apical setal processes (Figs. 3, 9)

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Figs. 5–10. *Bohpa maculata*. 5, Lateral view of head. 6, Lateral view of mesosoma (mesonotum detached from pleurae and metanotum + propodeum). 7, Dorsal view of mesosoma. 8, Highly modified forewing. 9, Scutellum and propodeum. 10, Dorsal view of head. Figs. 5–7, 9, 10, 0.05 mm; Fig. 8, 0.025 mm. Abbreviations: lax, first axillary sclerite; A1–3, annelli; anwp, anterior notal wing process; asp, apical setal process; fw, forewing; mn, metanotum; msp, mesopleuron; mtp, metapleuron; no, notauli (vestigial); po, posterior ocelli (vestigial); sp, propodeal spiracle; tg, tegula.

are variable in length and are often bilaterally asymmetrical.

DISCUSSION

The highly reduced forewings and the squat habitus of *Bohpa maculata*, with the gaster sessile due to reduction of metanotum, propodeum, and petiole, are reminiscent of the enigmatic *Tetracyclos boreios* Kryger. This species was studied in detail by Gibson and Yoshimoto (1981) and referred to Encyrtidae, but not without some extended discussion and caveats. Of particular interest is the similarity of the wing-like structures in *Tetracyclos* and *Bohpa*. Gibson and Yoshimoto (1981) described and illustrated the tegula of *Tetracyclos* as oval lobe-like structures (figs. 4-7; tg) and suggested that the forewing was represented by a knob-like thoracic process (figs. 6-7; tp). The thoracic process is now regarded as the first axillary sclerite (G. Gibson, *in litt.*) based on a detailed morphological study of the skeletomusculature of Eupelmidae and Encyrtidae (Gibson 1986); the forewing is completely absent in this species. In *Bohpa*, the tegula is very small and scale-like (Figs. 6, 8; tg) and it is the forewing that is modified into oval lobe-like structures. There are also similarities in the shape and orientation of the mesosomal sclerites in both genera. I regard the metanotum as strap-like in both genera. I think it is likely that the dorsal propodeal flange of *Tetracyclos* (Gibson and Yoshimoto 1981, fig. 5; dpf) is the metanotum and the structure labelled as the metanotum is the differentiated rim of the scutellum. Gibson and Yoshimoto also note that *Tetracyclos* is the only genus of Encyrtidae known to them in which the axillae are unrecognizable externally; similarly, the axillae are indistinct in *Bohpa*.

The structural similarities of the mesosoma must represent convergences in these two distantly-related genera of Chalcidoidea. Convergence is justification for speculation about the possible functional sig-

nificance of a character. In addition to being flightless, both *Bohpa* and *Tetracyclos* may be associated with leaf litter or other hypogaic habitats. The host of *T. boreios* has not been determined with certainty but the large series of specimens studied by Gibson and Yoshimoto (1981) were collected in pitfall traps, the same method used to collect the type material of *B. maculata*. By association, the host of *T. boreios* may be a species of *Pseudococcus* (Pseudococcidae) that feeds on *Dryas integrifolia* (Rosaceae) (see Gibson and Yoshimoto 1981 for details) but even if this host association is correct there is no indication of where on the plant the mealybug is feeding; mealybugs can be found on any part of the host plant, including the roots (Danzig 1986). Although the complete absence of protruding structures would seem advantageous for moving in confined spaces, the lobe-like "wings" of *Bohpa* and *Tetracyclos* may in some way facilitate locomotion. Movement of thoracic sclerites has been documented in *Tetracyclos* (Gibson and Yoshimoto 1981) but there is no evidence of a similar mechanism in *Bohpa*. The similarities in structure of these distantly related species are but one manifestation of the general trends that accompany the reduction or loss of wings in the Hymenoptera (Reid 1941) and additional morphological studies of wingless or brachypterous Chalcidoidea would be extremely interesting.

ACKNOWLEDGMENTS

I thank Dr. S. Endrödy-Younga, Coleoptera Department, Transvaal Museum for his assistance throughout the course of this study; he provided numerous sorted residues at my request and his samples provided the entire type series for this species. He also provided valuable information on the collection localities. Thanks is also extended to Dr. Charles Griswold, Smithsonian institution, for providing me with the names of his contacts in South Africa, and to the following curators and entomologists who

responded to my request for possible sources of additional specimens of Ceinae from South Africa: Dr. S. Louw (National Museum, Bloemfontein), and Prof. C. H. Scholtz (University of Pretoria). Lonny Coote prepared the scanning electron micrographs. Patricia Stevens-Bourgeault executed the drawings and assembled the plates and Catherine Rutland provided editorial assistance with the manuscript. Dr. Gary Gibson provided numerous valuable suggestions that improved the manuscript and also pointed out some errors in my initial morphological interpretations; this does not mean that he is in complete agreement with the behavioral and morphological interpretations presented herein.

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